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Maedo

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(54) **METHOD FOR RAISING RAISABLE AND LOWERABLE MEMBER, AND CRANE**

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B66C 23/68 (2006.01)

(52) **U.S. Cl.**
CPC ***B66C 23/82*** (2013.01); ***B66C 23/68*** (2013.01)

(58) **Field of Classification Search**
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USPC 212/270
See application file for complete search history.

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(57) **ABSTRACT**

A rope routing step and a raising step are executed. In the rope routing step, in a state where a raisable and lowerable member and a boom are laid down, a raising rope is coupled to the raisable and lowerable member and routed to extend rearward of the raisable and lowerable member. In the raising step, the raising rope is wound up rearward to raise the raisable and lowerable member. In the rope routing step, the raising rope is routed to pass between a lower restriction section and an upper restriction section of a rope support member, and in the raising step, the raising rope is wound up rearward with a vertical movement of the raising rope restricted by the upper restriction section and the lower restriction section.

4 Claims, 13 Drawing Sheets

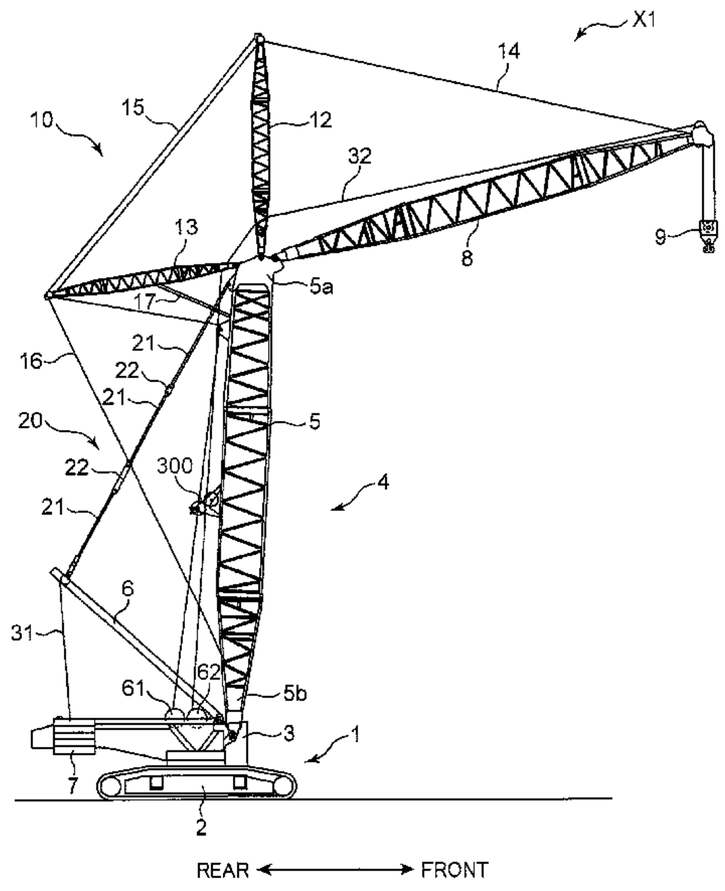

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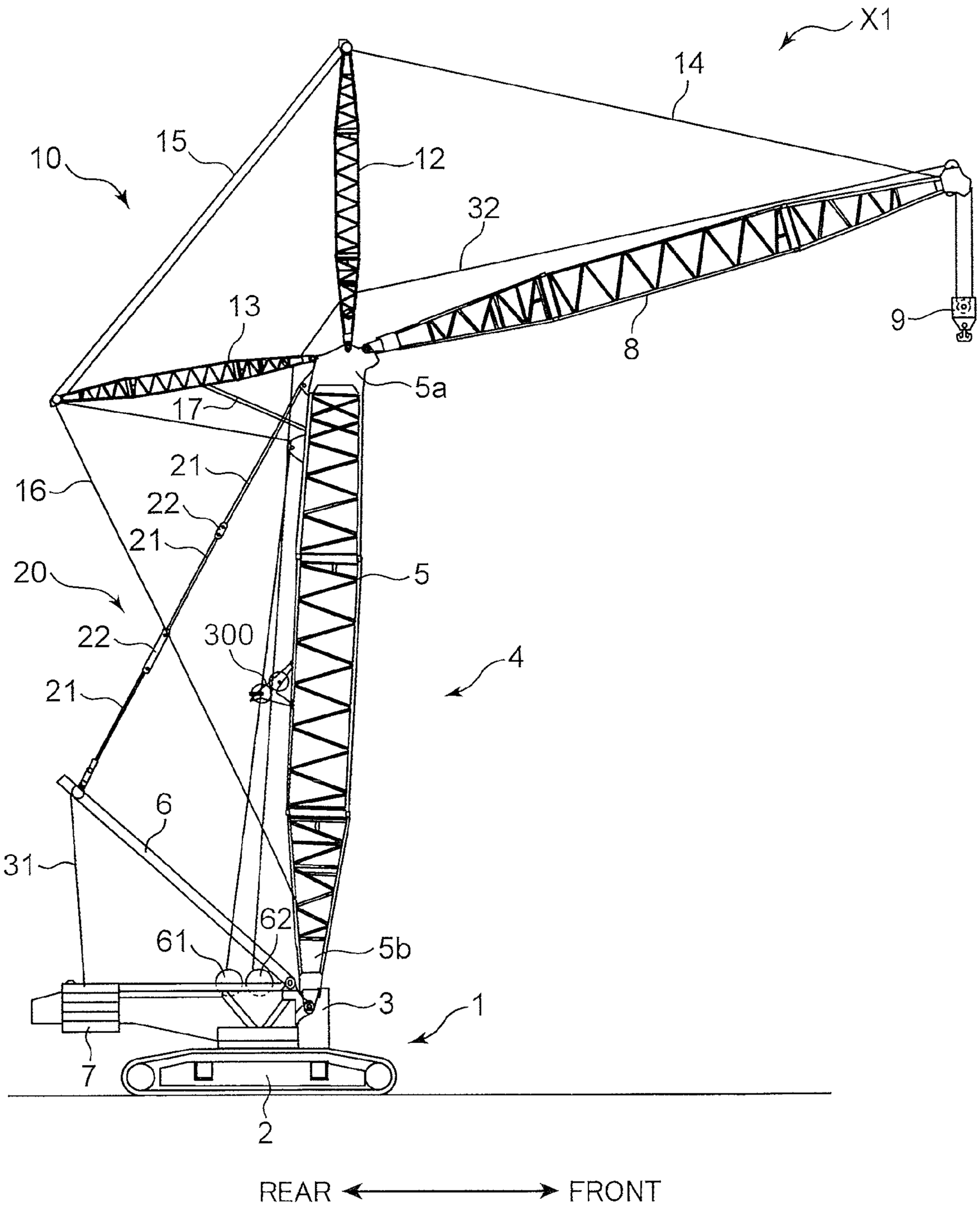
FIG. 1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14
15
10
12
32
13
9
8
5a
17
21
16
22
21
20
5
22
300
4
21
6
31
62
61
5b
3
1
7
2
REAR
FRONT

FIG. 2

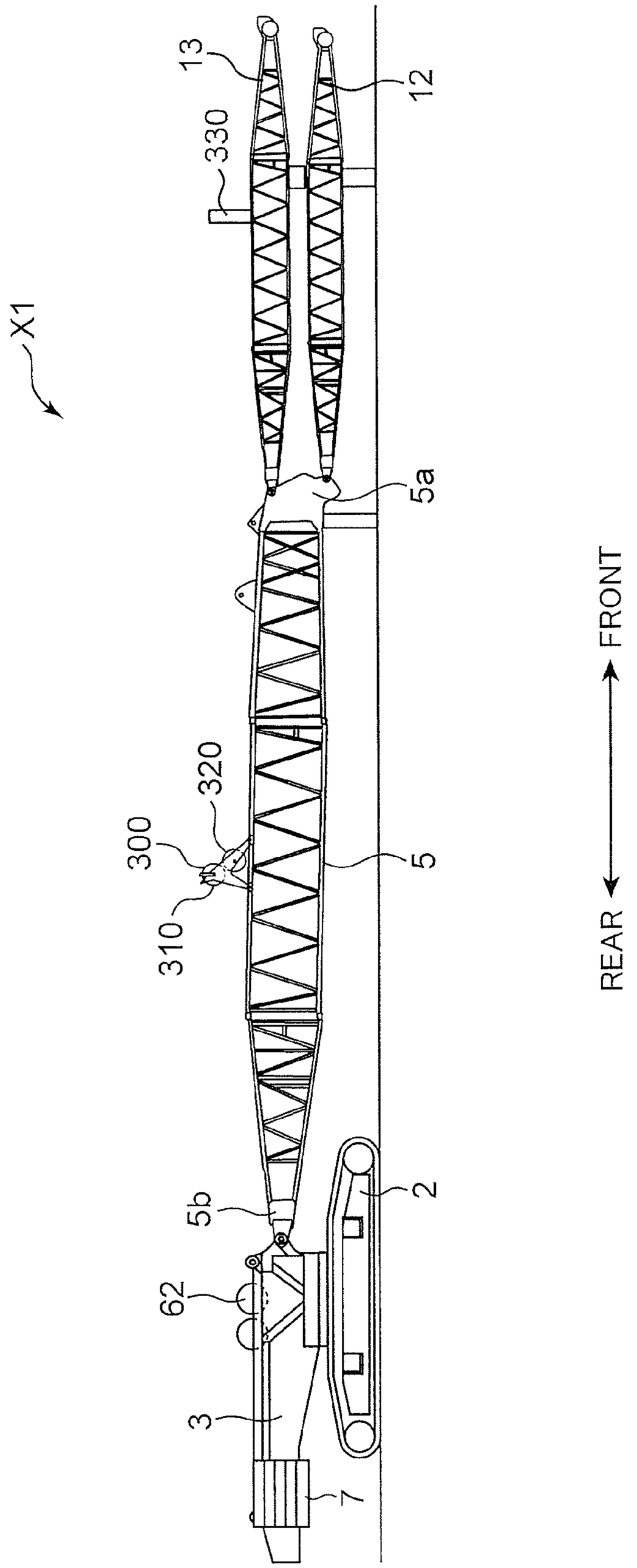


FIG. 3

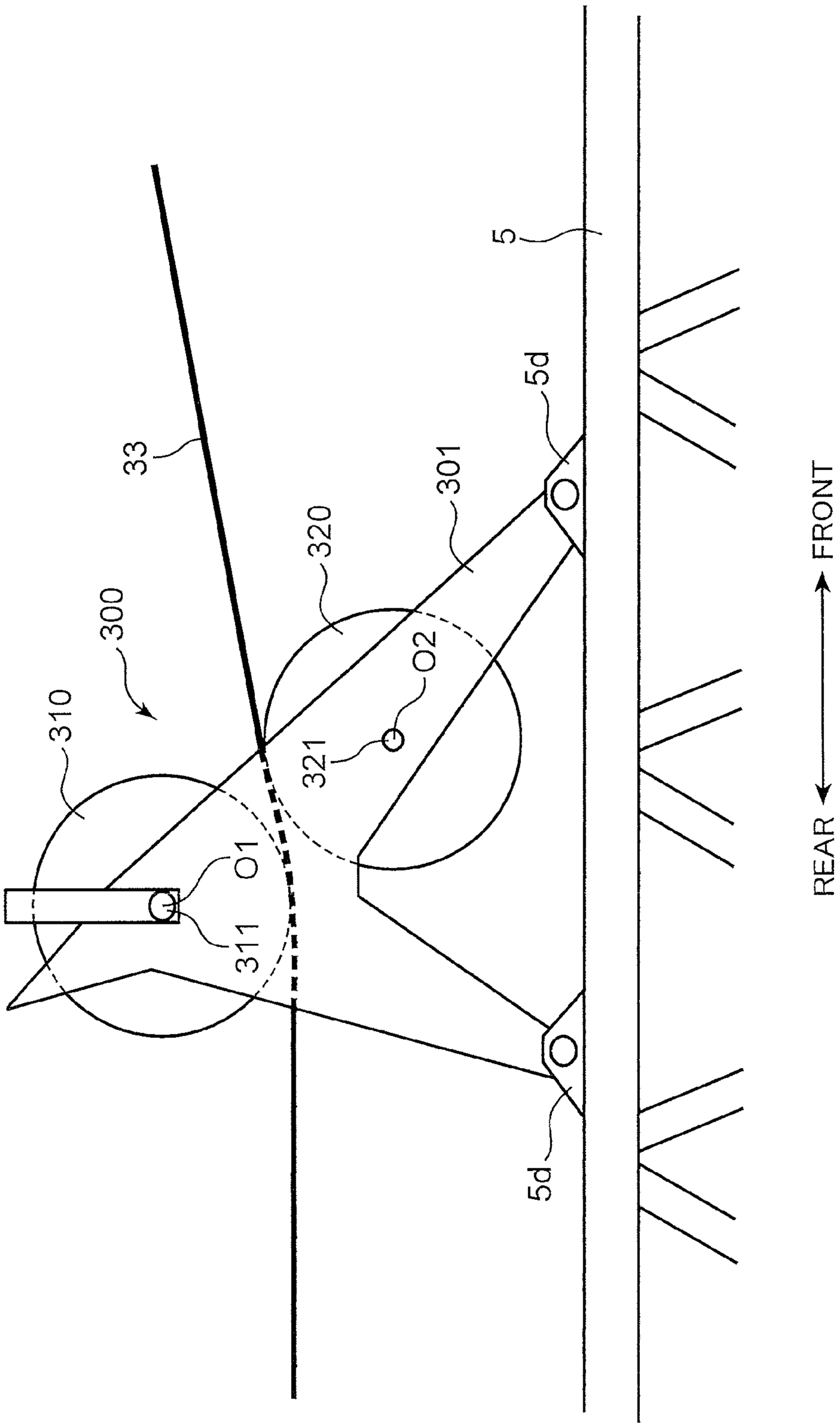


FIG. 4

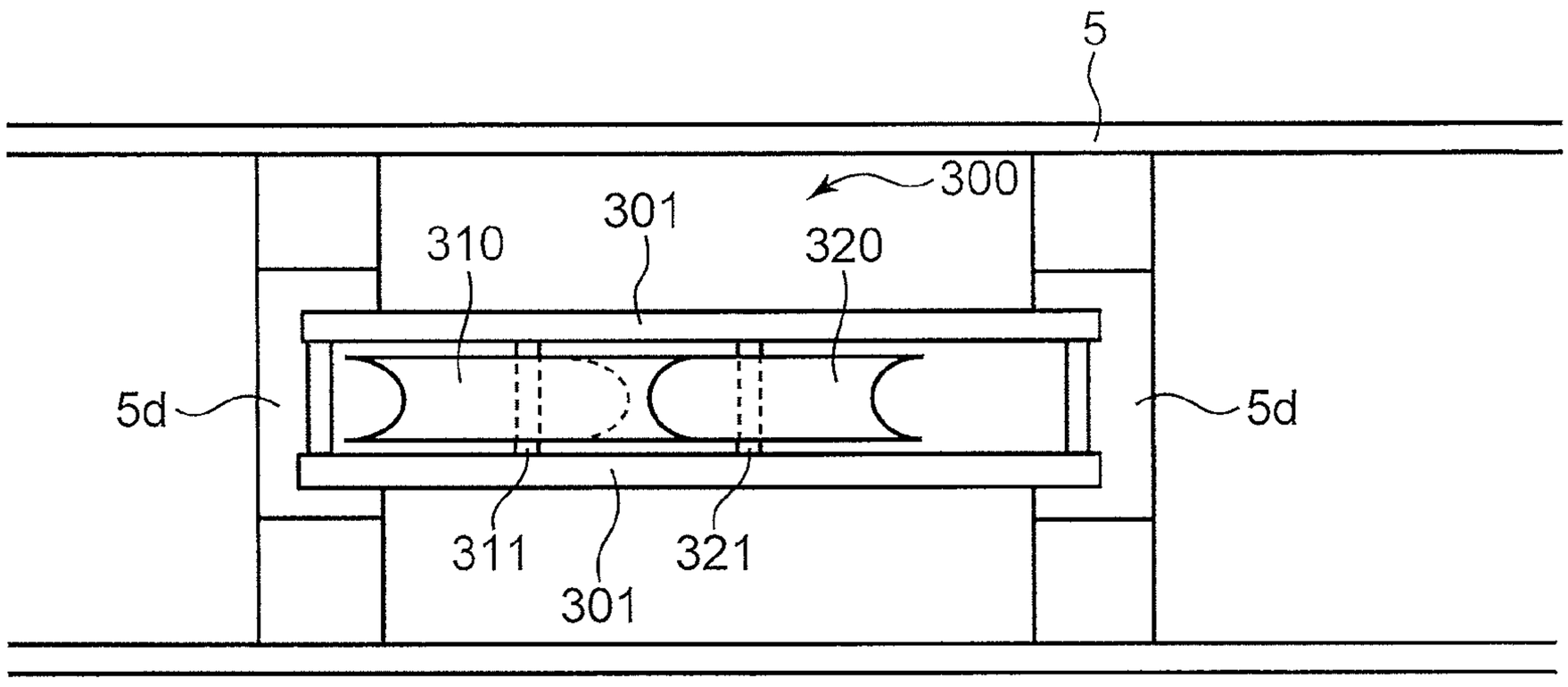
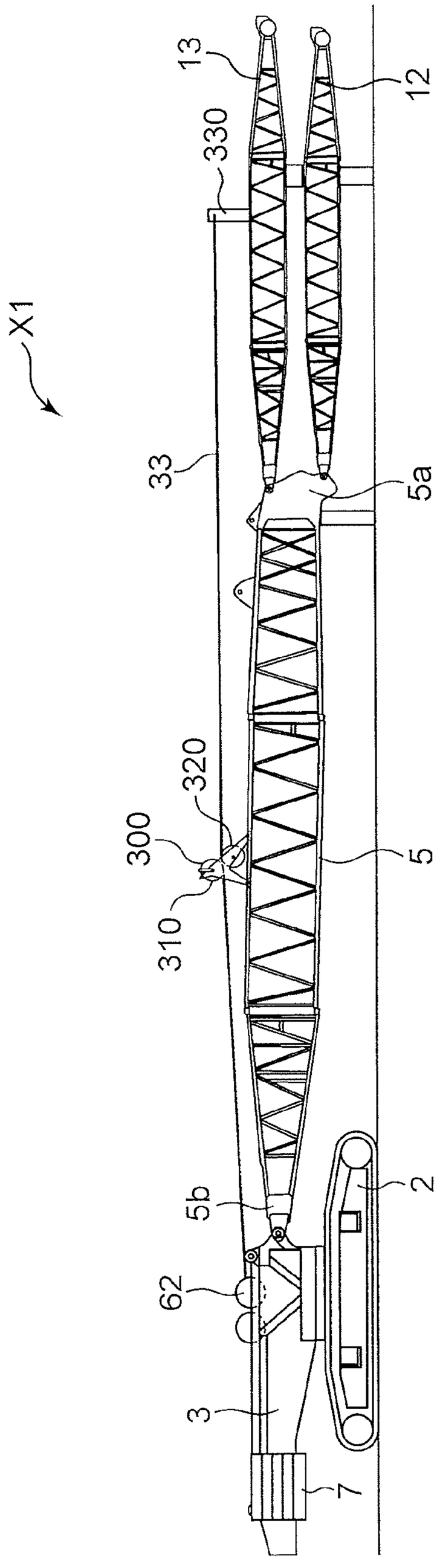


FIG. 5



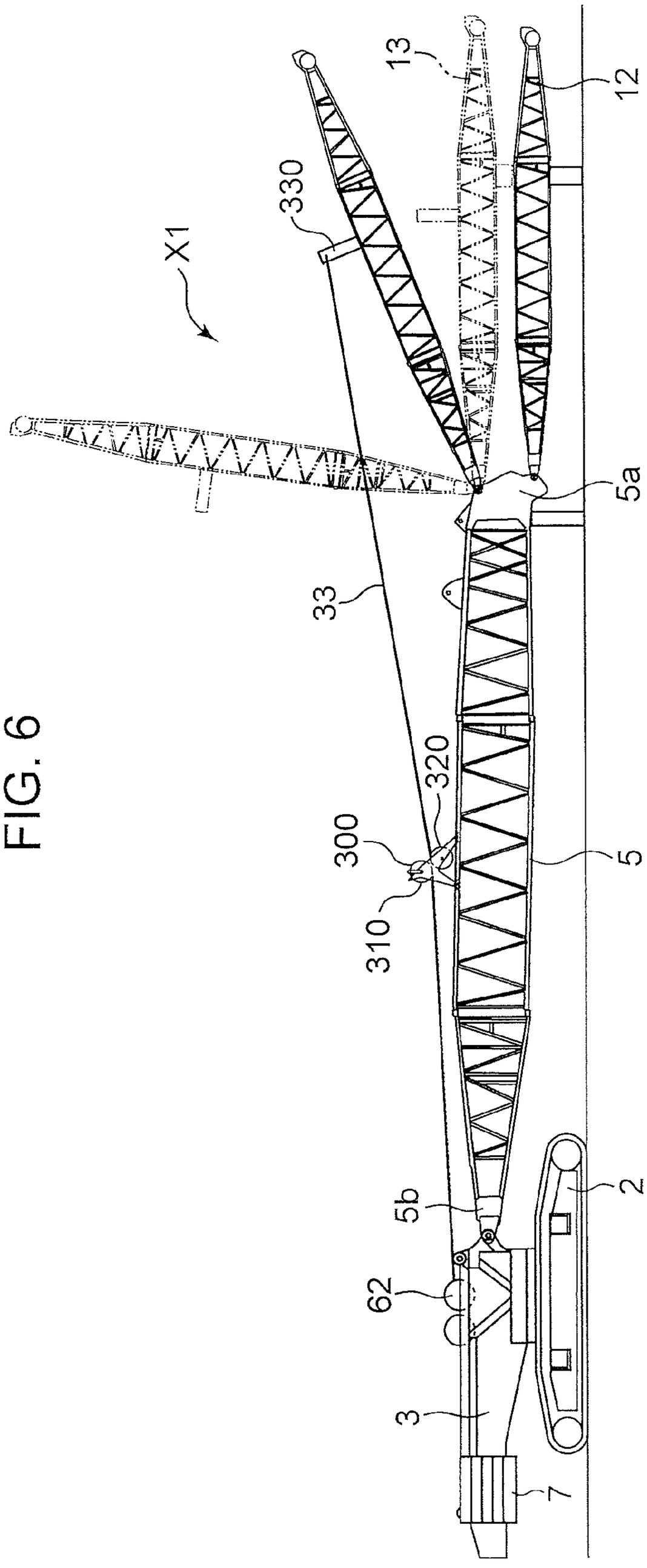
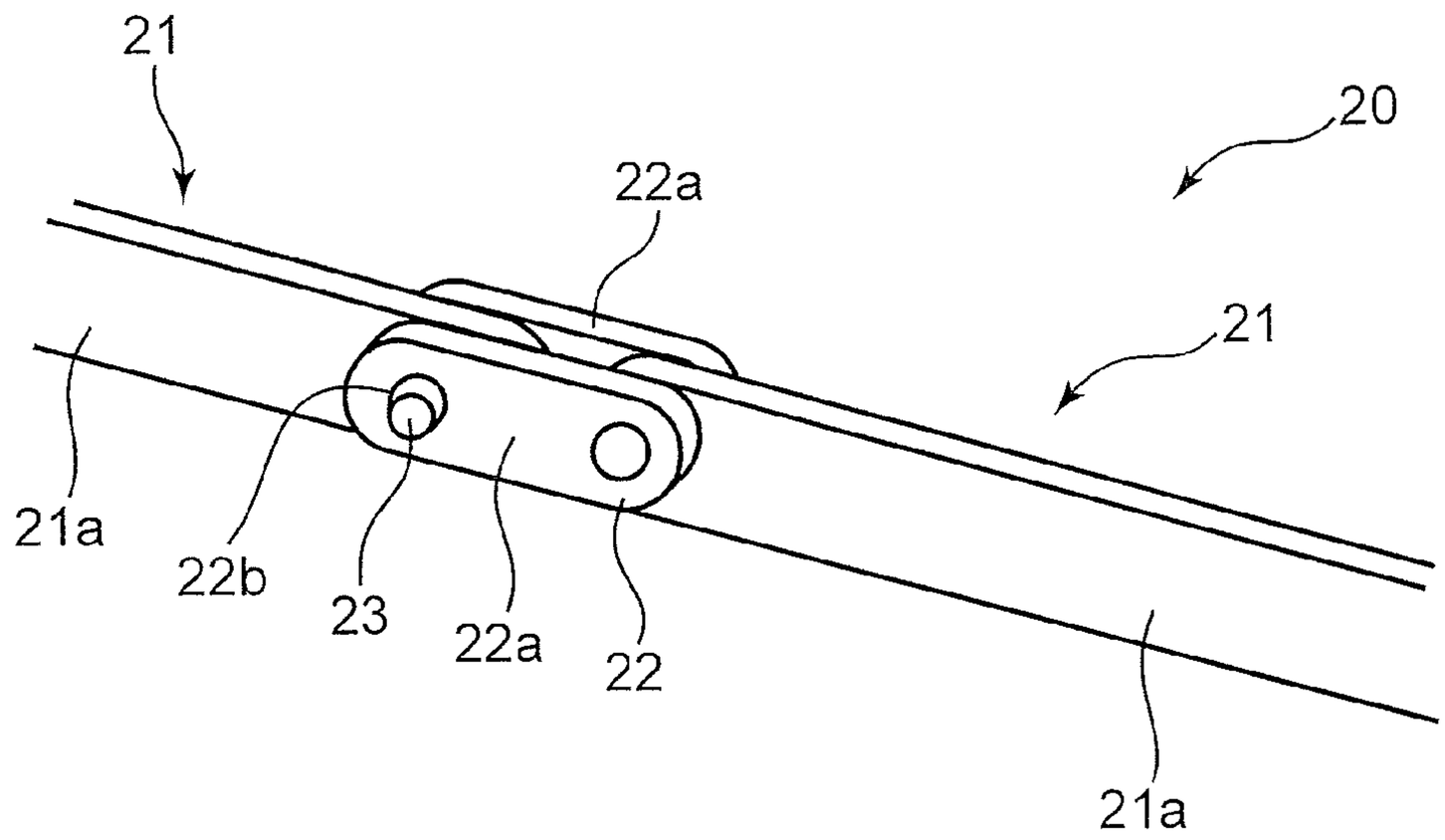
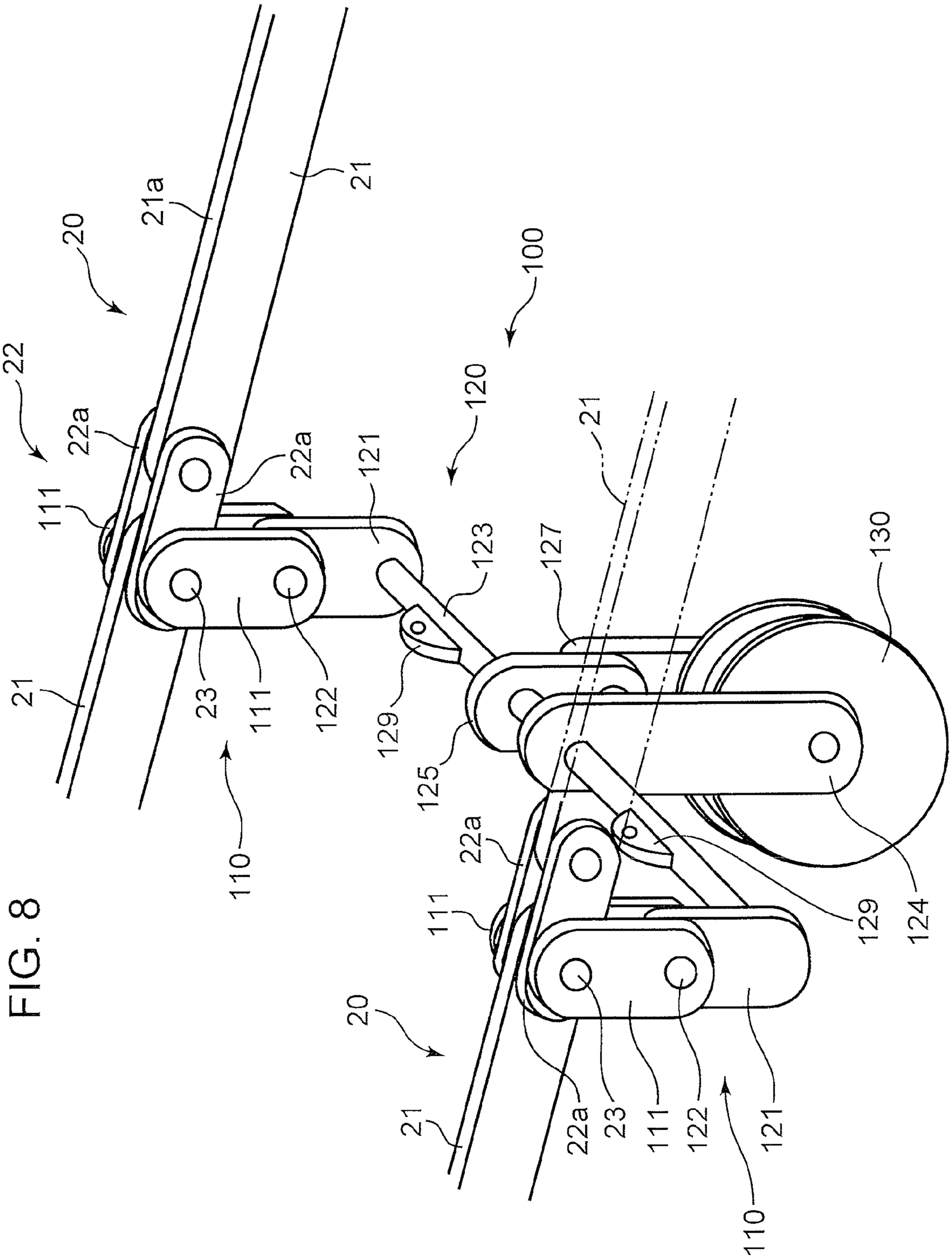


FIG. 6

FIG. 7

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21a
21
22
22a
111
22a
121
120
21
123
127
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21
23
111
122
129
125
110
100
22a
111
129
124
20
21
22a
23
111
122
121
110

FIG. 8

FIG. 9

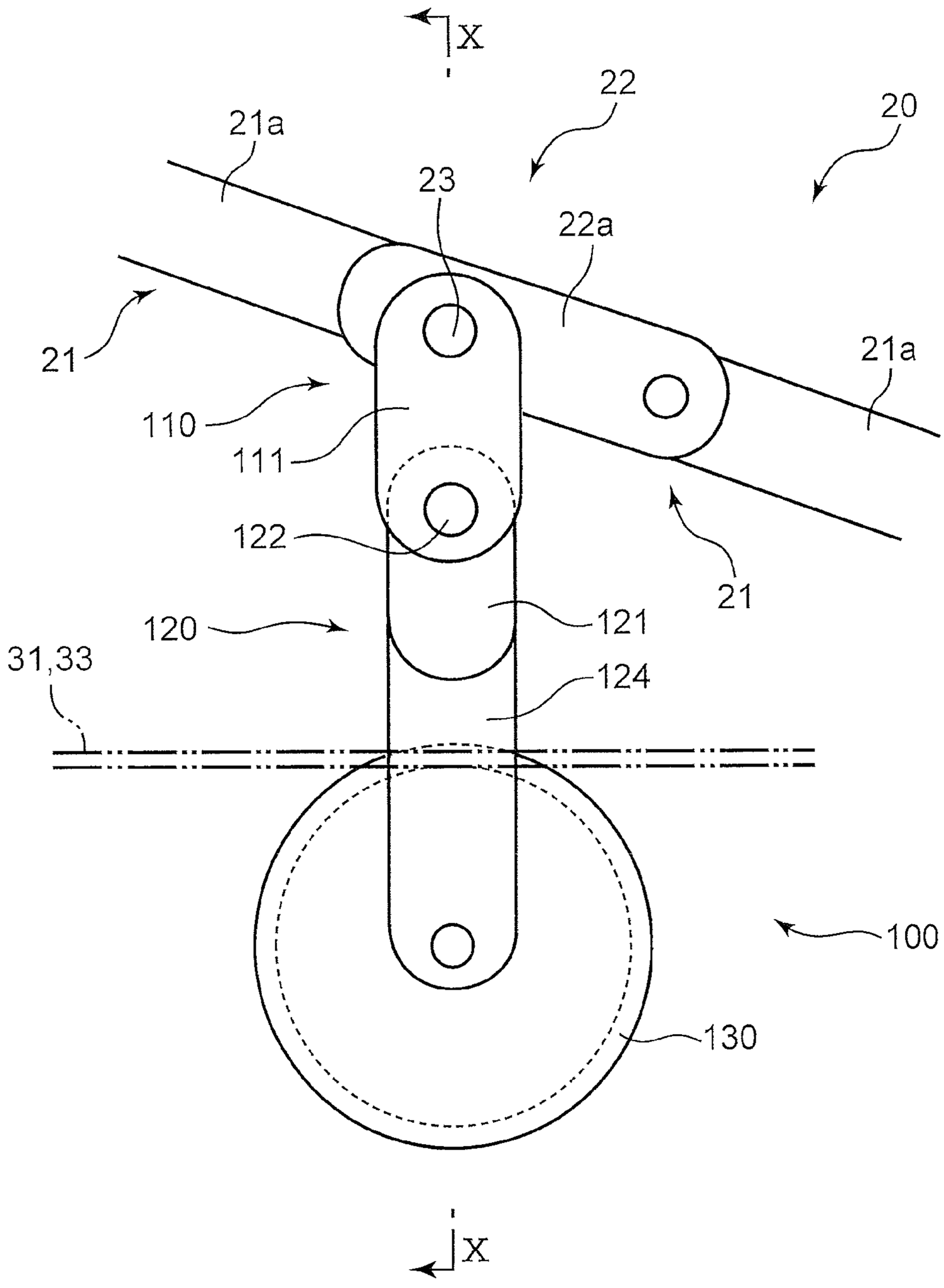
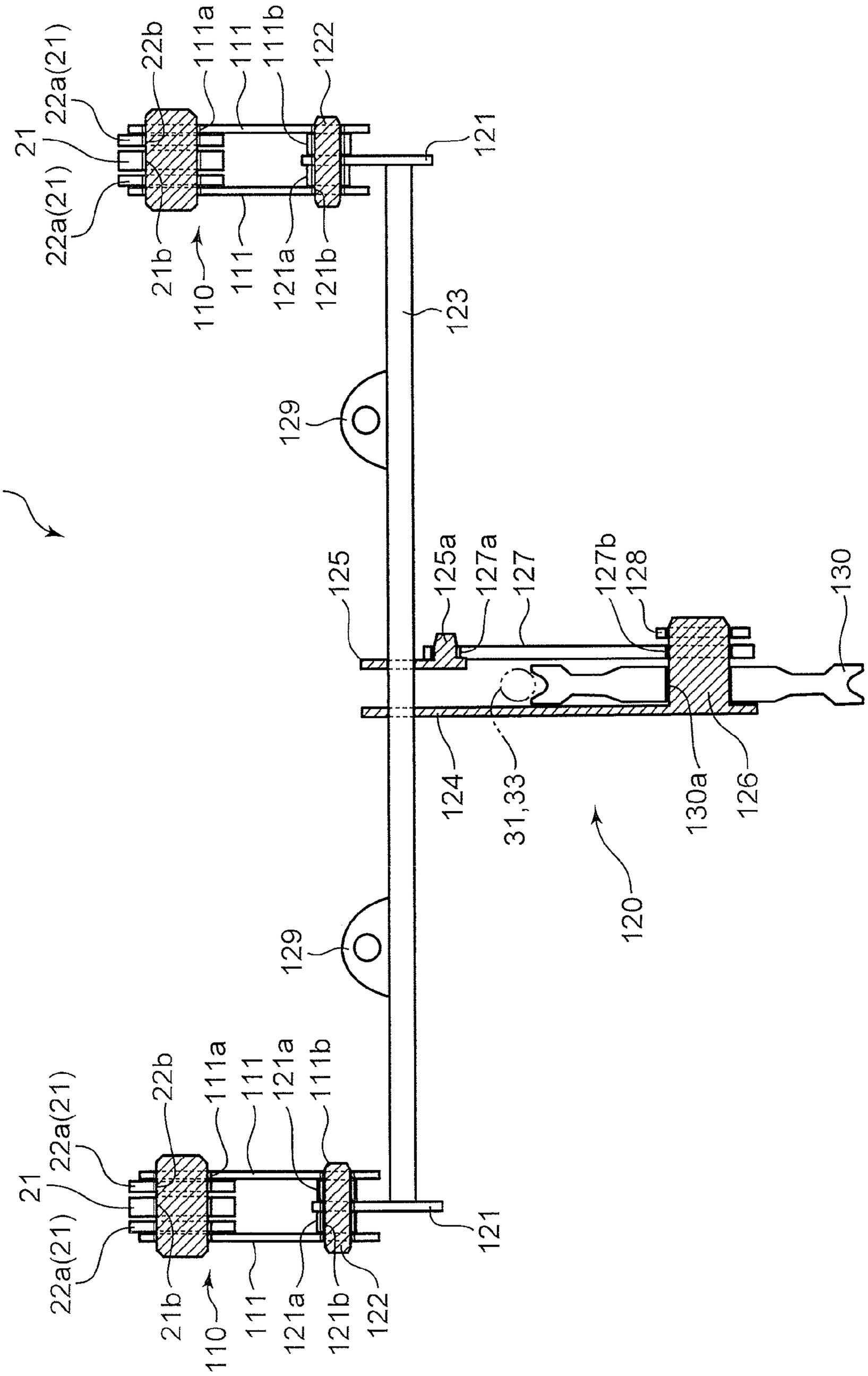


FIG. 10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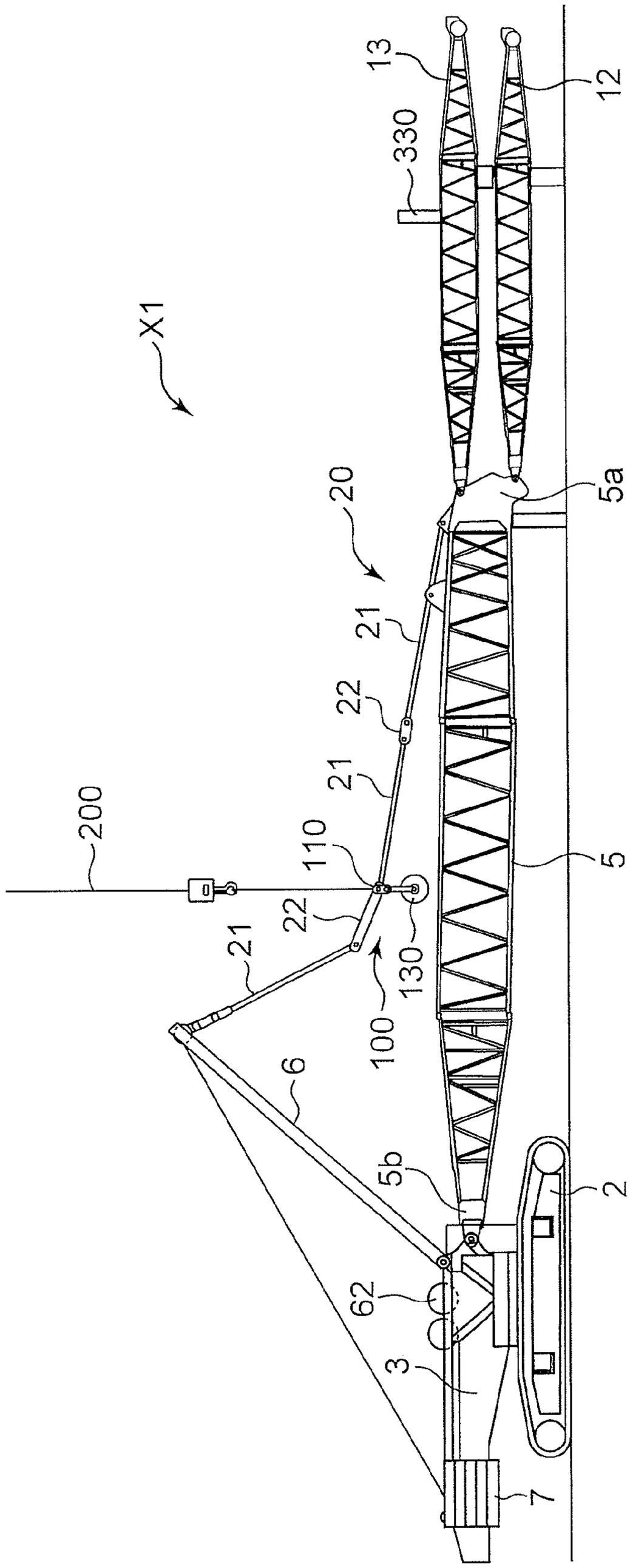
21
22a(21)
22a(21)
22b
111a
111
111b
122
121
21b
110
111
121a
121b
123
129
125
125a
127a
127
127b
128
130
124
31,33
130a
126
120
129
22a(21)
22a(21)
21
22b
111a
111
121a
111b
121
21b
110
111
121a
121b
122

FIG. 11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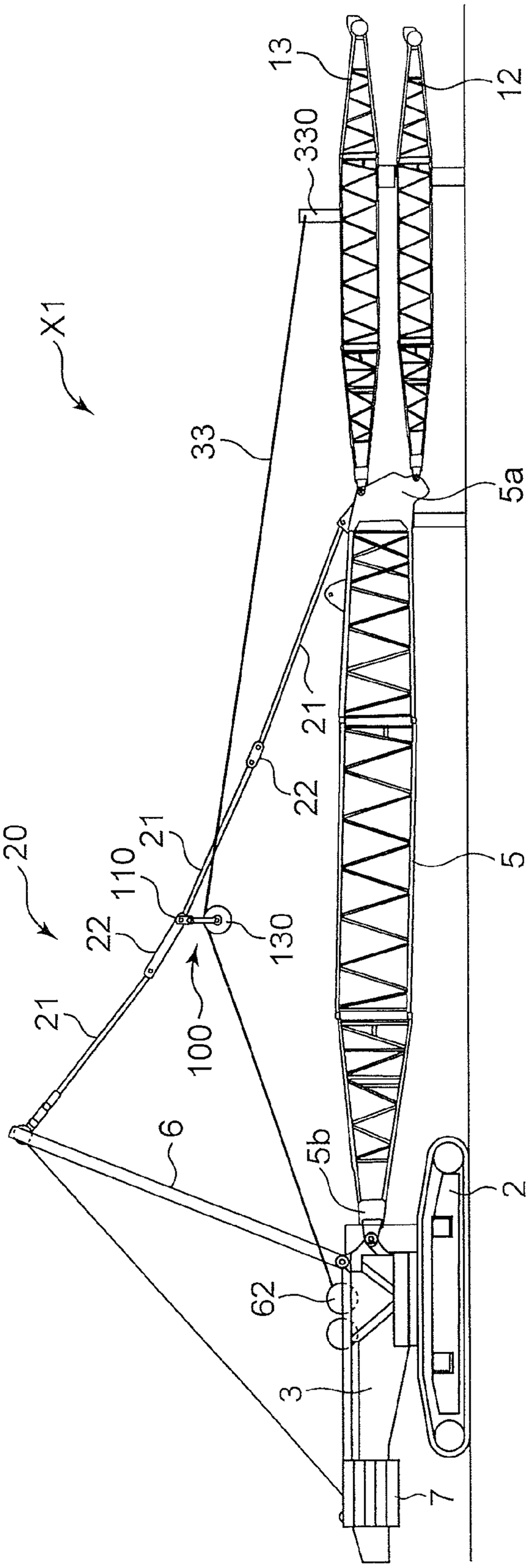
13
330
12
20
5a
21
22
21
200
110
5
22
21
130
100
6
5b
2
62
3
7
REAR
FRONT

FIG. 12


X1
13
330
12
33
5a
20
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110
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21
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5
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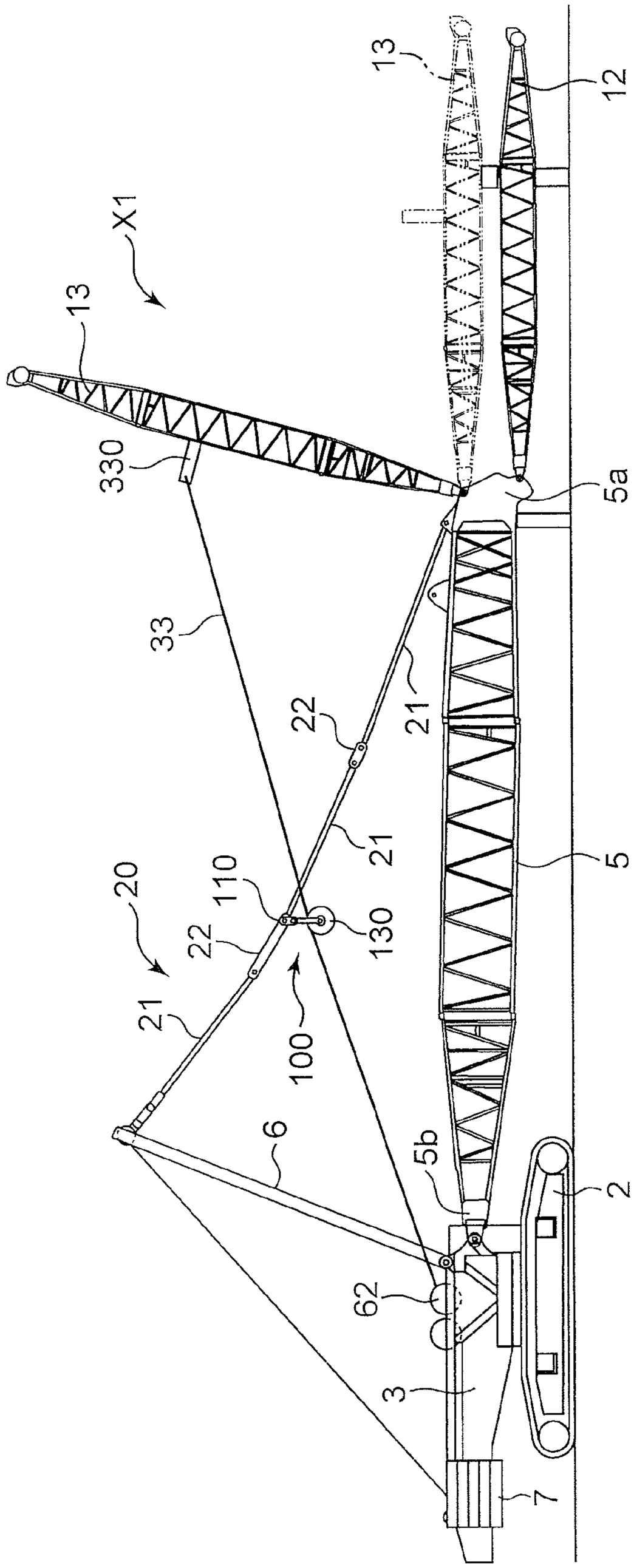
5b
2
62
3
7
REAR
FRONT

FIG. 13



METHOD FOR RAISING RAISABLE AND LOWERABLE MEMBER, AND CRANE

TECHNICAL FIELD

The present invention relates to a method for raising a raisable and lowerable member of a crane, and a crane.

BACKGROUND ART

Conventionally, there has been known a crane equipped with a machine body, a boom that is mounted to the machine body in a raisable and lowerable manner, and a raisable and lowerable member that can be raised and lowered with respect to the boom.

Such a crane may sometimes be assembled in a workplace where a work for suspending a load is performed. Specifically, the raisable and lowerable member and the boom which are laid down are raised. Thus, the crane becomes ready to suspend a load.

For example, Japanese Unexamined Patent Publication No. 2010-538930 discloses a method for raising a strut of a crane, the strut being mounted to a boom in a raisable and lowerable manner With this method, the strut is laid down, and with this state, a supporting post extending upward from the upper surface of the strut is attached to the strut. Next, a rope is connected to the supporting post. Then, the rope is wound up to the boom side, whereby the strut is raised.

However, with the method disclosed in Japanese Unexamined Patent Publication No. 2010-538930, that is, the method for raising the strut (raisable and lowerable member) by winding up the rope connected to the strut (raisable and lowerable member), if the raising amount of the raisable and lowerable member is small, the rope passes close to the upper surface of the boom. Therefore, an interference between the rope and the upper surface of the boom or various members mounted on the upper surface occurs, which is likely to damage the rope.

SUMMARY OF INVENTION

The present invention has been accomplished in view of the above-mentioned problems, and aims to provide a method for raising a raisable and lowerable member, and a crane, the method and crane make it possible to raise the raisable and lowerable member without causing damage to the rope.

In order to address the foregoing problems, the present invention provides a method for raising a raisable and lowerable member of a crane equipped with a machine body, a boom mounted to the machine body in a raisable and lowerable manner, and the raisable and lowerable member being raisable and lowerable with respect to the boom, the method comprising: a rope routing step of, in a state where the raisable and lowerable member and the boom are laid down along an installation surface on which the crane is placed, the boom extending forward of the machine body in a front-rear direction of the boom, the raisable and lowerable member extending forward of the boom in the front-rear direction of the boom, coupling a raising rope to the raisable and lowerable member and routing the raising rope to extend rearward of the raisable and lowerable member in the front-rear direction of the boom; and a raising step of winding up the raising rope rearward in the front-rear direction of the boom to raise the raisable and lowerable member with respect to the boom, the raising step being executed after the rope routing step. In the rope routing step, the raising rope is routed to pass between an upper restriction section and a lower restriction section of a rope support member attached to the boom, the lower restriction section being disposed at a position closer to the boom than the raising rope to support the raising rope at a position above an upper surface of the boom while allowing a movement of the raising rope in the front-rear direction of the boom, the upper restriction section being disposed at a position farther away from the boom than the raising rope to be contactable with the raising rope. In the raising step, the raising rope is wound up rearward in the front-rear direction of the boom with an upward movement of the raising rope restricted by the upper restriction section and a downward movement of the raising rope restricted by the lower restriction section.

The present invention also provides a method for raising a raisable and lowerable member of a crane equipped with a machine body, a boom mounted to the machine body in a raisable and lowerable manner, the raisable and lowerable member raisable and lowerable with respect to the boom, a support member that supports the boom and is raisable and lowerable with respect to the machine body, and a connection member for connecting a distal end of the boom and a distal end of the support member, the method comprising: a support member raising step of, in a state where the raisable and lowerable member and the boom are laid down along an installation surface on which the crane is placed with the raisable and lowerable member extending forward of the boom in a front-rear direction of the boom, raising the support member with respect to the machine body rearward of the boom in the front-rear direction of the boom such that the connection member obliquely extends forward and downward from the distal end of the support member toward the distal end of the boom; a rope routing step of coupling a raising rope to the raisable and lowerable member and routing the raising rope to extend rearward of the raisable and lowerable member in the front-rear direction of the boom; and a raising step of winding up the raising rope rearward in the front-rear direction of the boom to raise the raisable and lowerable member with respect to the boom, the raising step being executed after the support member raising step and the rope routing step. In in the rope routing step, the raising rope is routed to pass between an upper restriction section and a lower restriction section of a rope support member attached to the connection member, the lower restriction section being disposed at a position closer to the boom than the raising rope to support the raising rope at a position above an upper surface of the boom while allowing a movement of the raising rope in the front-rear direction of the boom, the upper restriction section being disposed at a position farther away from the boom than the raising rope to be contactable with the raising rope. In the raising step, the raising rope is wound up rearward in the front-rear direction of the boom with an upward movement of the raising rope restricted by the upper restriction section and a downward movement of the raising rope restricted by the lower restriction section.

The present invention also provides a crane comprising: a machine body; a boom mounted to the machine body in a raisable and lowerable manner; a raisable and lowerable member mounted in a raisable and lowerable manner with respect to the boom; and a rope support member that is attached to the boom to support a raising rope coupled to the raisable and lowerable member, wherein the rope support member includes a lower restriction section and an upper restriction section, the lower restriction section being disposed at a position closer to the boom than the raising rope to support the raising rope at a position above an upper

surface of the boom while allowing a movement of the raising rope in a front-rear direction of the boom in a preparatory state where the raisable and lowerable member and the boom are laid down along an installation surface on which the crane is placed with the boom extending forward of the machine body in the front-rear direction of the boom and with the raisable and lowerable member extending forward of the boom in the front-rear direction of the boom, the upper restriction section being disposed at a position farther away from the boom than the raising rope to be contactable with the raising rope in the preparatory state.

The present invention provides a method for raising a raisable and lowerable member and a crane which can ensure raising a raisable and lowerable member without causing damage to a rope.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a side view illustrating a configuration of a crane according to a first embodiment;

FIG. **2** is a side view of the crane to which a work for raising a rear strut has not yet been performed;

FIG. **3** is a side view illustrating, as enlarged, a part near a rope support member;

FIG. **4** is a top view corresponding to FIG. **2**;

FIG. **5** is a side view of the crane after a rope routing step is ended;

FIG. **6** is a side view of the crane to which a raising step is currently executed;

FIG. **7** is a perspective view illustrating, as enlarged, a joint portion between guy lines;

FIG. **8** is a perspective view of a guide member;

FIG. **9** is a side view of the guide member;

FIG. **10** is a sectional view along a line X-X in FIG. **9**;

FIG. **11** is a side view of a crane, according to a second embodiment, when the guide member is attached to a main guy line;

FIG. **12** is a side view of the crane according to the second embodiment after a rope routing step is ended; and

FIG. **13** is a side view of the crane, according to the second embodiment, to which a raising step is currently executed.

DESCRIPTION OF EMBODIMENTS

One embodiment of the present invention will now be described below with reference to the drawings. Note that, for the sake of convenience of description, each drawing referred to below briefly illustrates only main components of a crane X**1** according to the present embodiment. Therefore, it is possible that the crane X**1** according to the present embodiment includes, as appropriate, any components or any steps not illustrated in the drawings referred to in the present specification.

(1) First Embodiment

(1-1) Overall Configuration of Crane

FIG. **1** illustrates the crane X**1** according to the first embodiment of the present invention. FIG. **1** illustrates the assembled crane X**1**, that is, the crane X**1** which is ready to perform a work for suspending a load.

The crane X**1** illustrated in FIG. **1** includes a machine body **1** having a lower travelling body **2** and an upper slewing body **3** mounted on the lower travelling body **2**, and an attachment **4** attached to the upper slewing body **3**. In the following description, the horizontal direction in FIG. **1** and the horizontal direction in FIG. **2** are defined as a front-rear direction. The horizontal direction in FIG. **2** corresponds to the longitudinal direction of a boom **5** described later and the front-rear direction of the boom **5** in a state where the boom **5** is laid down along an installation surface on which the crane X**1** is placed.

The lower travelling body **2** of the machine body **1** is configured to be capable of traveling on a ground, and has a pair of crawlers, for example. The upper slewing body **3** of the machine body **1** is configured to be slewable about an axis extending in a direction perpendicular to a travel surface (that is, the installation surface on which the crane X**1** is placed) on which the lower travelling body **2** travels.

A main winch **62** for winding up and out a wire rope and a jib raising-lowering winch **61** are mounted on the upper slewing body **3**. It is to be noted that these winches **61** and **62** may be mounted on the boom **5** described later.

The attachment **4** is provided for a work for hoisting a load and a work for suspending a load.

The attachment **4** includes the boom **5**, a mast (support member) **6** connected to the boom **5**, a counterweight **7** mounted on the upper slewing body **3**, a jib **8** raisable and lowerable with respect to the boom **5**, a hook **9** for carrying a load, a strut unit **10**, and a main guy line (connection member) **20**.

The boom **5** has a base end **5***b* mounted to the upper slewing body **3** to be pivotable, and a distal end **5***a* opposite to the base end **5***b*. The main guy line **20** is a member for connecting the distal end **5***a* of the boom **5** (that is, the tip of the boom **5**) and the tip of the mast **6** mounted to the upper slewing body **3**. The boom **5** is supported by the mast **6** through the main guy line **20**.

The tip of the mast **6** is connected to the counterweight **7** through a wire rope **31**. When the wire rope **31** connecting the mast **6** and the counterweight **7** is wound up by a mast winch, the inclination angle of the mast **6** relative to the ground is changed. Thus, the boom **5** connected to the mast **6** is raised and lowered.

As described above, the main guy line **20** is a member for connecting the distal end **5***a* of the boom **5** and the tip of the mast **6**. In the present embodiment, two main guy lines **20** and **20** are arranged in the width direction (the direction orthogonal to the sheet surface of FIG. **1**, and this direction may be merely referred to as the width direction of the boom **5** in some cases) of the boom **5**. Each main guy line **20** includes a plurality of (three in FIG. **1**) boom guy links **21**. Specifically, the plurality of boom guy links **21** is connected such that one end of one of the boom guy links **21** is connected to the end of the adjacent boom guy link **21** in the longitudinal direction, thereby forming one main guy line **20**.

A rope support member **300** is mounted near the center (near the center in the vertical direction in FIG. **1**) of the boom **5** in the longitudinal direction. The detailed structure of the rope support member **300** will be described later.

The jib **8** is mounted at the distal end **5***a* of the boom **5**. The base end of the jib **8** is mounted to the distal end **5***a* of the boom **5** to be pivotable. Thus, the jib **8** is raisable and lowerable with respect to the boom **5** and the machine body **1**.

The hook **9** is hung from the tip of the jib **8**. A wire rope **32** connected to the main winch **62** is coupled to the hook **9**. The hook **9** is hung from the tip of the jib **8** to be movable in the vertical direction by the wire rope **32** being wound up or out by the main winch **62**.

The strut unit **10** supports the jib **8** at the back of the jib **8** to prevent the jib **8** from falling forward. The strut unit **10**

has a front strut **12**, a rear strut **13**, a jib guy line **14**, a jib raising-lowering wire rope **15**, and a strut guy line **16**.

The front strut **12** is mounted at the distal end **5***a* of the boom **5** in a raisable and lowerable manner with respect to the boom **5** and the machine body **1**. The rear strut **13** is disposed behind the front strut **12**. The rear strut **13** is mounted at the distal end **5***a* of the boom **5** in a raisable and lowerable manner with respect to the boom **5** and the machine body **1**. The strut guy line **16** connects the tip of the rear strut **13** and a base end part of the boom **5**. In the present embodiment, the jib **8** is supported by two struts, the front strut **12** and the rear strut **13**. However, the jib **8** is not limited thereto, and may be supported by only one strut.

The jib guy line **14** connects the tip of the front strut **12** and the tip of the jib **8**. The jib **8** is supported by the front strut **12**.

The front strut **12** and the rear strut **13** are connected to each other by the jib raising-lowering wire rope **15**. The jib raising-lowering wire rope **15** is connected to the jib raising-lowering winch **61**. The jib raising-lowering winch **61** winds up and out the jib raising-lowering wire rope **15**. Due to the jib raising-lowering wire rope **15** being wound up and out, the angle made by the front strut **12** and the rear strut **13** is changed. Thus, the jib **8** is raised and lowered with respect to the boom **5**.

(1-2) Rope Support Member

In a place where a load is to be suspended, the boom **5**, the jib **8**, and the strut unit **10** which are laid down on the installation surface on which the crane X**1** is placed are raised, and the crane X**1** is assembled to be ready to suspend a suspended load (load) as illustrated in FIG. **1**. The rope support member **300** is used for the raising process described above.

FIG. **2** is a view illustrating the crane X**1** before the boom **5** and the strut unit **10** are raised. Before the raising process, the crane X**1** is in a state (preparatory state) where the boom **5** and the strut unit **10** are laid down on the installation surface, such as a ground, so as to extend along the installation surface with the boom **5** extending forward of the machine body **1** and the strut unit **10** extending forward of the boom **5**. In the present embodiment, the strut unit **10** is laid down in a position in which the rear strut **13** is located above the front strut **12** as illustrated in FIG. **2**. Note that FIG. **2** does not illustrate the jib **8**. In the following description of the rope support member **300**, the vertical direction in FIG. **2** is merely referred to as a vertical direction. FIG. **3** is a side view illustrating, as enlarged, a part of FIG. **2** near the rope support member **300**. FIG. **4** is a top view corresponding to FIG. **3**.

In the state illustrated in FIG. **2**, the rope support member **300** is located at almost the central part of the upper surface (the upper surface in FIG. **2**) of the boom **5** in the front-rear direction to project upward from the upper surface. The rope support member **300** has a pair of support sections **301** and **301** attached to the upper surface of the boom **5**, and two pulleys **310** and **320**. The two pulleys **310** and **320** are configured of rotary body.

The support sections **301** and **301** have a plate shape and face each other in the width direction of the boom **5**. The support sections **301** and **301** are attached to a pair of mounting sections **5***d* and **5***d* arranged in the front-rear direction on the upper surface of the boom **5**. In the present embodiment, each support section **301** is bifurcated into a front part and a rear part on the lower part thereof. The front parts at the lower parts of the respective support sections **301** are attached to the front mounting section **5***d*. The rear parts at the lower parts of the respective support sections **301** are attached to the rear mounting section **5***d*. The respective support sections **301** and **301** extend upward from the upper surface of the boom **5**. That is, the respective support sections **301** and **301** extend in the front-rear direction and in the vertical direction.

The two pulleys **310** and **320** are supported by the support sections **301** and **301** between the support sections **301** and **301**. Specifically, the rope support member **300** has two shafts **311** and **321** extending between the two support sections **301** and **301**. The two pulleys **310** and **320** are supported respectively by the shafts **311** and **321** to be rotatable about the shafts **311** and **321**.

The two pulleys **310** and **320** are disposed to be shifted from each other in the vertical direction and in the front-rear direction. Specifically, the two pulleys **310** and **320** have almost the same diameter and same thickness (the size in the width direction of the boom **5**). A rotation center O**1** and an upper end position of the pulley **310** are above a rotation center O**2** and an upper end position of the other pulley **320**. Further, the rotation center O**1** and a rear end position of the upper pulley **310** (hereinafter referred to as the upper sheave **310**) are respectively posterior to the rotation center O**2** and a rear end position of the lower pulley **320** (hereinafter referred to as the lower sheave **320**).

The distances between the rotation center O**1** of the upper sheave **310** and the rotation center O**2** of the lower sheave **320** in the front-rear direction and the vertical direction are smaller than the diameter of the sheaves **310** and **320**. Thus, the upper sheave **310** and the lower sheave **320** are disposed to be partially overlapped with each other in a top view and in a front view. In addition, the lower sheave **320** is disposed such that the lower end thereof is above the upper surface of the boom **5**.

As described later, in a state where the raising rope **33** is routed between the upper sheave **310** and the lower sheave **320**, the upper sheave **310** can be in contact with the raising rope **33** from above. As described above, the upper sheave **310** functions as an upper contact member that can be in contact with the raising rope **33** from above. In addition, as described later, in the state where the raising rope **33** is routed between the upper sheave **310** and the lower sheave **320**, the lower sheave **320** can be in contact with the raising rope **33** from below. As described above, the lower sheave **320** functions as a lower contact member that can be in contact with the raising rope **33** from below.

It is to be noted that the support sections **301** and **301** may have any shapes that can support the upper sheave **310** and the lower sheave **320**, and are not limited to have the shape described in the present embodiment. That is, the support sections **301** and **301** may not have a plate shape or a bifurcated shape.

(1-3) Procedure for Raising Raisable and Lowerable Member

Next, a procedure for raising the raisable and lowerable member that can be raised and lowered with respect to the machine body **1** and the boom **5** by using the rope support member **300** will be described. In the present embodiment, the procedure for raising the rear strut **13**, which is one of components serving as the raisable and lowerable member, with respect to the boom **5** will be described. In the description of the procedure, the vertical direction in FIG. **2** is also merely referred to as a vertical direction.

(Preparatory Step)

First, the crane X**1** is brought into the state illustrated in FIG. **2** (that is, in the state where the boom **5** and the strut unit **10** are laid down on the installation surface, such as a ground, so as to extend along the installation surface with

the boom **5** extending forward of the machine body **1** and the strut unit **10** extending forward of the boom **5**), as described above.

In addition, a raising bar **330** is attached on the upper surface of the rear strut **13** as illustrated in FIG. **2**. The raising bar **330** has a shape extending in a predetermined direction. The raising bar **330** is attached to the rear strut **13** to project upward from the upper surface of the rear strut **13**. In the present embodiment, the raising bar **330** is attached at almost the central part of the rear strut **13** in the front-rear direction. Note that the raising bar **330** may be formed integrally with the rear strut **13**, and in such a case, the step of attaching the raising bar **330** to the rear strut **13** is skipped.

(Rope Routing Step)

Next, the raising rope **33** which is a wire rope for raising the rear strut **13** is coupled to the rear strut **13**. In the present embodiment, the raising rope **33** is coupled to the rear strut **13** through the raising bar **330**. In addition, the raising rope **33** is routed to extend rearward from the rear strut **13** through the upper sheave **310** and the lower sheave **320** of the rope support member **300**.

Specifically, the raising rope **33** wound around the main winch **62** is pulled forward from the main winch **62**. Then, as illustrated in FIG. **3**, the raising rope **33** is pulled to the raising bar **330** while passing between the upper sheave **310** and the lower sheave **320** of the rope support member **300**. Then, the end of the raising rope **33** is coupled to the raising bar **330**. In the present embodiment, the raising rope **33** is coupled to the upper end of the raising bar **330**. Thus, the raising rope **33** is routed to extend from the upper end of the raising bar **330** to the main winch **62** through between the upper sheave **310** and the lower sheave **320** of the rope support member **300**, while being supported by the lower sheave **320**, as illustrated in FIG. **5**.

As described above, the upper sheave **310** and the lower sheave **320** are disposed to be overlapped with each other in a front view. Therefore, as illustrated in FIG. **3**, the raising rope **33** is routed to be in contact with the outer peripheral surfaces of both sheaves **310** and **320**.

In the present embodiment, the wire rope wound around the main winch **62** is used as the raising rope **33** as described above. However, the wire rope wound around the jib raising-lowering winch **61** may be used as the raising rope **33** instead. Alternatively, the raising rope **33** and the winch may be additionally prepared.

(Raising Step)

Next, the raising rope **33** is wound up rearward to raise the rear strut **13** with respect to the boom **5**.

Specifically, the raising rope **33** is wound up by the main winch **62**. Thus, the raising rope **33** moves rearward through between the upper sheave **310** and the lower sheave **320**. In the present embodiment, the raising rope **33** is routed to be in contact with the upper sheave **310** and the lower sheave **320** of the rope support member **300** as described above. Thus, the raising rope **33** moves while rotating the upper sheave **310** and the lower sheave **320**.

Due to the wind-up of the raising rope **33** described above, the rear strut **13** pivots about the joint portion between the rear strut **13** and the distal end **5***a* of the boom **5** from the position indicated by a broken line to the position indicated by a solid line in FIG. **6**. In the present embodiment, the rear strut **13** is raised up to erect almost upright from the distal end **5***a* of the boom **5** as indicated by a chain line in FIG. **6**.

(1-4) Operation and Others

As described above, in the present embodiment, the rear strut **13** is raised by winding up the raising rope **33** connected to the rear strut **13**. Thus, it is unnecessary to prepare a crane or the like for hoisting the rear strut **13** for raising the rear strut **13**. Accordingly, this configuration provides a cost advantage. Further, it is unnecessary to ensure a space for installing a hoisting crane. Accordingly, the rear strut **13** can be raised in less space.

Moreover, the raising rope **33** is wound up while being supported at a position above and distant from the upper surface of the boom **5** by the rope support member **300**. Therefore, an interference between the raising rope **33** and the upper surface of the boom **5** or various members provided on the upper surface of the boom **5** can be prevented while winding up the raising rope **33**. Accordingly, damage to the raising rope **33** caused by the interference can be suppressed.

Furthermore, the raising rope **33** moves through between the upper sheave **310** and the lower sheave **320** of the rope support member **300** while being wound up. Therefore, the vertical movement of the raising rope **33** is restricted by the sheaves **310** and **320**, whereby a strong vertical swing of the raising rope **33** accompanied by the movement can be suppressed. Accordingly, the interference between the raising rope **33** and the other members caused by the vertical swing can also be suppressed, whereby damage to the raising rope **33** can more reliably be suppressed.

Particularly, in the present embodiment, the raising rope **33** moves while being in contact with the outer peripheral surfaces of both sheaves **310** and **320** as described above. Therefore, the vertical swing of the raising rope **33** can reliably be reduced.

Further, in the present embodiment, the upper sheave **310** and the lower sheave **320** are pulleys, and the raising rope **33** moves while rotating these sheaves. Therefore, the raising rope **33** can smoothly be moved.

In addition, in the present embodiment, the raising rope **33** is connected to the raising bar **330** projecting upward from the upper surface of the rear strut **13**. Therefore, when the raising rope **33** is wound up, a high rotation moment can be applied to the rear strut **13**. Accordingly, the rear strut **13** can efficiently be raised.

(2) Second Embodiment

Next, a crane X1 and a procedure for raising a raisable and lowerable member according to the second embodiment of the present invention will be described.

In the second embodiment, a rope support member **100** illustrated in FIGS. **8** to **10** is used instead of the rope support member **300** illustrated in FIG. **3** or other drawings. The configuration other than the rope support member is the same between the first embodiment and the second embodiment, and the description for the configuration other than the rope support member will be omitted below. The rope support member **100** according to the second embodiment is used by being attached to the main guy line **20**. FIGS. **8** and **9** are each a schematic perspective view and a side view of the rope support member **100** attached to the main guy line **20**. FIG. **10** is a sectional view along a line X-X in FIG. **9**. Note that a portion of a hatched line indicating a cross section is not illustrated in FIG. **10** for clarification. In the following description, the rope support member **100** according to the second embodiment is referred to as a guide member **100**.

(2-1) Structure of Main Guy Line

The structure of the main guy line **20** to which the guide member **100** is attached will be described.

In the present embodiment, two main guy lines **20** and **20** are arranged in the width direction (the direction orthogonal to the sheet surface of FIG. **1**, and this direction may be merely referred to as the width direction of the boom **5** in some cases) of the boom **5**. Each main guy line **20** includes a plurality of (three in FIG. **1**) boom guy links (unit connection members) **21**. Specifically, the plurality of boom guy links **21** is connected such that one end of one of the boom guy links **21** is connected to the end of the adjacent boom guy link **21** in the longitudinal direction, thereby forming one main guy line **20**.

FIG. **7** is a schematic perspective view illustrating, as enlarged, a joint portion between the boom guy links **21**. As illustrated in FIG. **7**, the boom guy link **21** has a main body part **21***a* extending in a predetermined direction, and a boom-side link part **22** attached to one end of the main body part **21***a* in the longitudinal direction. The boom-side link part **22** includes a pair of boom-side link plates **22***a* and **22***a*. The boom-side link plates **22***a* and **22***a* are attached to the end of the main body part **21***a* with this end being held therebetween. Each boom-side link plate **22***a* extends from the end of the main body part **21***a* in the direction away therefrom. A through-hole **22***b* is formed at the tip of each boom-side link plate **22***a*.

An end of one of the boom guy links **21** is inserted between the boom-side link plates **22***a* and **22***a* of the adjacent boom guy link **21**. A pin **23** (hereinafter referred to as a guy link connection pin **23** as appropriate) is inserted into a through-hole **21***b* (see FIG. **10**) formed at the end of one of the boom guy links **21** and the through-holes **22***b* and **22***b* formed in the boom-side link plates **22***a* and **22***a* of the other boom guy link **21**. Thus, the adjacent two boom guy links **21** are connected to each other.

(2-2) Structure of Guide Member

The detailed structure of the guide member **100** will be described.

The guide member **100** includes a pulley for guiding (this pulley corresponds to the lower restriction section and is hereinafter referred to as a guide pulley) **130**, a support section **120** that supports the guide pulley **130** in a rotatable manner, and a pair of link sections **110** and **110** for connecting the support section **120** to the main guy lines **20**. The guide pulley **130** is configured of rotary body.

The link sections **110** are individually attached respectively to a pair of main guy lines **20** and **20** arranged parallel to each other. The two link sections **110** and **110** are symmetrical (symmetrical in the horizontal direction in FIG. **10**, that is, the two link sections **110** and **110** are symmetrical in the width direction of the boom **5** in a state where they are respectively attached to the main guy lines **20** and **20**). Now, one of the link sections **110** will be described.

In the present embodiment, the link section **110** is attached to the boom-side link part **22** of the main guy line **20**. The link section **110** has a pair of link plates **111** and **111** extending in the vertical direction. Through-holes **111***a* and **111***b* are respectively formed at the upper end and the lower end of each link plate **111**. The two link plates **111** and **111** hold the boom-side link plates **22***a* and **22***a* of the boom guy link **21** from the outside. The guy link connection pin **23** is inserted into the through-holes **111***a* and **111***a* of the link plates **111**. Thus, the link section **110** is attached to the boom-side link part **22**, that is, the joint portion between the two boom guy links **21**. In such a fixation state, the respective link plates **111** are pivotable about the center axis of the guy link connection pin **23**.

The support section **120** has a pair of connection plates **121**. The pair of connection plates **121** and **121** is connected to the link sections **110** and **110**, respectively, whereby the support section **120** is coupled to the link sections **110**. Each connection plate **121** is a plate-shaped member extending upward. The connection structures between the connection plates **121** and the link sections **110** are symmetrical (symmetrical in the horizontal direction in FIG. **10**). Now, one of the connection structures between the connection plate **121** and the link section **110** will be described.

Pin receiving sections **121***a* and **121***a* respectively projecting from the front surface and the back surface of the connection plate **121** are provided on the upper part of the connection plate **121**. The connection plate **121** is formed with a pin receiving hole **121***b* extending from the surface of one of the pin receiving sections **121***a* to the surface of the other pin receiving section **121***a* and penetrating through the connection plate **121**. A pin **122** is inserted into the pin receiving hole **121***b* and the through-holes **111***b* and **111***b* formed at the lower parts of the link plates **111** and **111** of the link section **110**. Thus, the connection plate **121** is connected to the link section **110**.

Each connection plate **121** is connected to the corresponding link section **110** as described above, whereby the support section **120** and the guide pulley **130** supported by the support section **120** are attached to the main guy line **20**.

The support section **120** has a supporting rod **123** extending between the two connection plates **121** and **121**. A first support plate **124** and a second support plate **125** which extend downward from the supporting rod **123** are attached at almost the center of the supporting rod **123** in the longitudinal direction (horizontal direction in FIG. **10**). The first support plate **124** and the second support plate **125** are arranged with a predetermined space therebetween in the longitudinal direction of the supporting rod **123**. A columnar shaft **126** projecting toward the second support plate **125** is provided at the lower end of the first support plate **124**. As described below, the supporting rod **123** can be in contact with the raising rope **33** from above in a state where the raising rope **33** is supported by the guide member **100**. In this way, the supporting rod **123** functions as an upper contact member that can be in contact with the raising rope **33** from above.

The guide pulley **130** has a through-hole **130***a* formed at the central part of a disk-shaped member. The shaft **126** is inserted through the through-hole **130***a*. Due to the shaft **126**, the guide pulley **130** is supported to be rotatable about the shaft **126**. The guide pulley **130** is disposed between the first support plate **124** and the second support plate **125** in the longitudinal direction of the supporting rod **123**. With the guide member **100** being attached to the main guy lines **20**, the guide pulley **130** is disposed between a pair of main guy lines **20** and **20**. As described below, the guide pulley **130** can be in contact with the raising rope **33** from below in a state where the raising rope **33** is supported by the guide member **100**. In this way, the guide pulley **130** functions as a lower contact member that can be in contact with the raising rope **33** from below.

The support section **120** further includes a holding section **127** that is detachably attached to the second support plate **125** and the shaft **126**. The holding section **127** is a plate-shaped member extending downward beyond the shaft **126** from the lower end of the second support plate **125**. The second support plate **125** is provided with, at its lower end, a protrusion **125***a* protruding toward the side opposite to the first support plate **124** (protruding to the right in FIG. **10**). Through-holes **127***a* and **127***b* that penetrate through the

holding section **127** from the front surface to the back surface are formed at the upper end and the lower end of the holding section **127**.

The protrusion **125***a* of the second support plate **125** and the shaft **126** are respectively fitted to the through-holes **127***a* and **127***b* of the holding section **127**. Thus, the holding section **127** is coupled to the second support plate **125** and the shaft **126**. A retaining pin **128** is inserted into a portion of the shaft **126**, the portion protruding outward (to the right in FIG. **10**) from the holding section **127**. Thus, the outward movement of the holding section **127** is restricted. More specifically, a through-hole penetrating in the vertical direction is formed at the end of the shaft **126**. The retaining pin **128** is inserted into this through-hole.

The holding section **127** is attached to the second support plate **125** and the shaft **126** as described above, whereby the guide pulley **130** is held by the first support plate **124** and the holding section **127** at a position between them.

In the present embodiment, the support section **120** is hoisted by a crane or the like while supporting the guide pulley **130**, and carried to the position where the support section **120** is to be coupled to the main guy lines **20** and **20** (specifically, the position where the support section **120** is to be coupled to the link sections **110** and **110** attached to the main guy lines **20** and **20**). To this end, a wire attaching section **129** to which a lifting wire is attached is provided to the supporting rod **123**. A pair of wire attaching sections **129** and **129** respectively projecting upward is provided at symmetrical positions with respect to the center of the supporting rod **123** in the longitudinal direction.

(2-3) Procedure for Raising Raisable and Lowerable Member

Next, a procedure for raising the rear strut **13** according to the second embodiment will be described. In the following description, the vertical direction in FIG. **2** is also merely referred to as a vertical direction.

(Preparatory Step)

As in the first embodiment, first, the crane X**1** is brought into the state (the state illustrated in FIG. **2**) where the boom **5** and the strut unit **10** are laid down on the installation surface, such as a ground, so as to extend along the installation surface with the boom **5** extending forward of the machine body **1** and the strut unit **10** extending forward of the boom **5**. On the other hand, in the second embodiment, the mast **6** is raised at the rear of the boom **5** with respect to the machine body **1** such that the main guy line **20** obliquely extends forward and downward toward the distal end **5***a* of the boom **5** from the tip (upper end) of the mast **6** (support member raising step), as illustrated in FIG. **11**. It is to be noted that, in the first embodiment, the process for raising the mast **6** may be performed in the preparatory step.

In the present embodiment, to facilitate the mounting of the guide member **100** to the main guy line **20**, the raised amount of the mast **6** is set to be smaller than the maximum amount (the amount by which the main guy line **20** extends upright) such that the main guy line **20** bends at the joint portion between the boom guy links **21** as illustrated in FIG. **11**. That is, the part, which is located at the distal end of the boom **5**, of the main guy line **20** is located below a position when the raising amount of the mast **6** is the maximum.

Then, the guide member **100** is attached to the main guy line **20**. The position where the guide member **100** is attached is not particularly limited. In the present embodiment, the guide member **100** is attached such that a force is applied to the rear strut **13** from the raising rope **33** at a position distant from the pivot center of the rear strut **13** in the later-described raising step. That is, the guide member **100** is attached such that the raising rope **33** pulls the rear strut **13** at a higher position to enable efficient raising of the rear strut **13**. Specifically, the guide member **100** is attached at the joint portion between the boom guy links **21**, the joint portion being at a position on the rear from the center of the main guy line **20** in the front-rear direction.

More specifically, a pair of link sections **110** of the guide member **100** is first attached to the main guy lines **20**. As described above, the link plates **111** of the guide member **100** are attached to the boom-side link part **22** by inserting the guy link connection pin **23** into the through-holes **111***a* at the upper ends of the link plates **111**. Thus, the link section **110** is attached to the boom-side link part **22**, that is, the joint portion between the boom guy links **21**.

Thereafter, the support section **120** supporting the guide pulley **130** is hoisted by another crane **200** and disposed near the link sections **110**. More specifically, a wire is attached to the wire attaching sections **129** of the support section **120**. The wire is then hoisted by the crane **200**, and the support section **120** and the guide pulley **130** are carried between the link sections **110**.

Next, the support section **120** is attached to the link sections **110**. Specifically, the support section **120** and the link sections **110** are connected by inserting the pins **122** into the pin receiving holes **121***b* in the connection plates **121** of the support section **120** and the through-holes **111***b* of the link plates **111**.

After the support section **120** and the link sections **110** are connected, the crane **200** and the support section **120** are decoupled, and the guide member **100** is hung from the main guy line **20**.

(Rope Routing Step)

Next, the raising rope **33** is coupled to the rear strut **13**. In the second embodiment as well, the raising rope **33** is coupled to the rear strut **13** through the raising bar **330**. On the other hand, in the second embodiment, the raising rope **33** is routed to pass between the supporting rod **123** and the guide pulley **130**.

Specifically, the raising rope **33** wound around the main winch **62** is pulled forward from the main winch **62**. Then, as illustrated in FIG. **12**, the raising rope **33** is pulled to the raising bar **330** while passing between the supporting rod **123** and the guide pulley **130** of the guide member **100**. Then, the end of the raising rope **33** is coupled to the upper end of the raising bar **330**. Thus, the raising rope **33** is routed to extend to the main winch **62** from the upper end of the raising bar **330** through between the supporting rod **123** and the guide pulley **130** of the guide member **100**. In this state, the raising rope **33** is placed on the outer peripheral surface of the guide pulley **130** and supported by this outer peripheral surface. In addition, the supporting rod **123** is disposed at a position where the supporting rod **123** can be in contact with the raising rope **33** from above.

In the present embodiment, as described above, the raising rope **33** is routed with the raised amount of the mast **6** being set to be smaller than the maximum amount (the amount by which the main guy line **20** extends upright), that is, with the guide member **100** being at a lower position, such that the main guy line **20** bends at the joint portion between the boom guy links **21** as illustrated in FIG. **11**. Therefore, the raising rope **33** can easily be routed. After the routing of the raising rope **33** is finished, the mast **6** is raised upward as illustrated in FIG. **12**. Thus, the guide member **100** and the portion, which is supported by the guide member **100**, of the raising rope **33** move upward.

(Raising Step)

Next, as in the first embodiment, the raising rope **33** is wound up by the main winch **62**. Thus, the rear strut **13** is raised with respect to the boom **5** from the state indicated by a broken line to the state indicated by a solid line in FIG. **13**.

It should be noted here that, in the second embodiment, the raising rope **33** moves rearward through between the supporting rod **123** and the guide pulley **130** of the guide member **100** while rotating the guide pulley **130**.

(Guide Member Removing Step)

After the process for raising the rear strut **13** is finished, the guide member **100** is removed from the main guy line **20**. Specifically, the guide member **100** is removed from the main guy line **20** in the procedure reverse to the procedure for mounting the guide member **100** to the main guy line **20**.

(2-4) Operation and Others

As described above, in the second embodiment as well, the rear strut **13** is raised by winding up the raising rope **33** coupled to the rear strut **13**. Therefore, as in the first embodiment, the rear strut **13** can be raised in less space at low cost.

Moreover, in the second embodiment, the raising rope **33** is also wound up while being supported at a position above and distant from the upper surface of the boom **5** by the guide member **100**. Therefore, an interference between the raising rope **33** and the upper surface of the boom **5** or the like can be prevented, whereby damage to the raising rope **33** can be suppressed.

Further, in the second embodiment as well, the raising rope **33** moves through between the supporting rod **123** and the guide pulley **130** of the guide member **100**. Therefore, the vertical movement of the raising rope **33** can be restricted by the supporting rod **123** and the guide pulley **130**. Accordingly, the interference between the raising rope **33** and the other members caused by the vertical swing of the raising rope can also be suppressed, whereby damage to the raising rope **33** can more reliably be suppressed.

In particular, in the second embodiment, the guide member **100** is attached to the main guy line **20** obliquely extending forward and downward toward the distal end **5***a* of the boom **5** from the tip of the mast **6**. Therefore, the distance from the upper surface of the boom **5** to the guide member **100** and the raising rope **33** supported by the guide member **100** can be increased with the vertical size of the guide member **100** being reduced. Accordingly, works for carrying and attaching the guide member **100** are facilitated, while the interference between the raising rope **33** and the upper surface of the boom **5** or the like can effectively be prevented.

Further, in the second embodiment, the guide pulley **130** is also a pulley, and the raising rope **33** also moves while rotating the guide pulley **130**. Therefore, the raising rope **33** can smoothly be moved.

In addition, in the second embodiment as well, the raising rope **33** is connected to the raising bar **330** projecting upward from the upper surface of the rear strut **13**, as in the first embodiment. Therefore, the rear strut **13** can efficiently be raised by applying a high rotation moment thereto.

(3) Modifications

Each of the above embodiments describes the case where the rear strut **13** is raised with respect to the boom **5**. However, the configuration and method according to each of the above embodiments are also applicable to raise other members (for example, the front strut **12** and the jib) with respect to the boom **5**.

The first embodiment describes the case where the upper sheave **310** and the lower sheave **320** are disposed such that the raising rope **33** is in contact with the outer peripheral surfaces of these sheaves. However, these sheaves **310** and **320** may be disposed to be capable of being in contact with the raising rope **33** from above and from below.

The first embodiment describes the case where the upper sheave **310** and the lower sheave **320**, which are pulleys, are used as members contactable with the raising rope **33** from above and from below. However, members having other structures may be used as a member which is contactable with the raising rope **33** from above and from below. For example, in place of the pulley, a structure provided with a plurality of rotary members rotating about an axis extending in the width direction of the boom **5** may be used. Alternatively, a non-rotatable member may be used. However, if a member rotating about an axis extending in the width direction of the boom **5** is used as a member contactable with the raising rope **33** from above and from below, the raising rope **33** can smoothly be moved in the front-rear direction.

Similarly, in the second embodiment, a member provided with a plurality of rotary members or a non-rotatable member may also be used in place of the guide pulley **130**.

Further, in the second embodiment, the member for restricting the upward movement of the raising rope **33** is not limited to the supporting rod **123** of the guide member **100**. For example, it is appreciated to provide a member which is located above the raising rope **33** and contactable with the raising rope **33** above the guide pulley **130**.

The above embodiments describe the case where the guide member **100** is attached to the boom-side link part **22**. However, the method and structure for attaching the guide member **100** to the main guy line **20** arc not limited thereto. For example, the guide member **100** may be directly attached to the main body part **21***a* of the boom guy link **21** by using a clamp or the like. However, the guide member **100** can easily be attached to the main guy line **20** according to the above-mentioned structure and procedure of using the guy link connection pin **23** provided to the boom-side link part **22** for connecting the guy links **21** and inserting this pin **23** into the through-holes **111***a* of the link plates **111**.

In addition, the guide member **100** may be attached to the main guy line **20** in a non-detachable manner. Accordingly, the step of removing the guide member **100** from the main guy line **20** may be skipped. However, the above-mentioned configuration in which the guide member **100** is removed can avoid a situation where efficiency is deteriorated due to the weight of the crane X**1** being increased by the guide member **100** during a work not requiring the guide member **100** such as a work for suspending a load by the crane X**1**.

While the above embodiments describe the case where the raising rope **33** is coupled to the raising bar **330** projecting upward from the upper surface of the rear strut **13**, the raising rope **33** may be directly coupled to the rear strut **13**. However, the configuration of using the raising bar **330** enables efficient raising of the rear strut **13** by applying a high rotation moment to the rear strut **13**.

The above embodiments describe the case where the crane X**1** has the front strut **12** and the rear strut **13** as a strut. However, the crane X**1** may have only one strut or may not have the strut unit **10**.

The present invention provides a method for raising a raisable and lowerable member of a crane equipped with a machine body, a boom mounted to the machine body in a raisable and lowerable manner, and the raisable and lowerable member raisable and lowerable with respect to the boom, the method comprising: a rope routing step of cou-

pling a raising rope to the raisable and lowerable member, in a state where the raisable and lowerable member and the boom are laid down along an installation surface on which the crane is placed with the boom extending forward of the machine body in a front-rear direction of the boom and with the raisable and lowerable member extending forward of the boom in the front-rear direction of the boom, and routing the raising rope to let the raising rope extend rearward of the raisable and lowerable member in the front-rear direction of the boom; and a raising step of winding up the raising rope rearward in the front-rear direction of the boom to raise the raisable and lowerable member with respect to the boom, the raising step being executed after the rope routing step, wherein in the rope routing step, the raising rope is routed to pass between an upper restriction section and a lower restriction section of a rope support member attached to the boom, the lower restriction section being disposed at a position closer to the boom than the raising rope to support the raising rope at a position above an upper surface of the boom while allowing a movement of the raising rope in the front-rear direction of the boom, the upper restriction section being disposed at a position farther away from the boom than the raising rope to be contactable with the raising rope, and in the raising step, the raising rope is wound up rearward in the front-rear direction of the boom while the upper restriction section restricts an upward movement of the raising rope and the lower restriction section restricts a downward movement of the raising rope.

According to this method, the raisable and lowerable member is raised by winding up the raising rope coupled to the raisable and lowerable member. Therefore, it is unnecessary to prepare a crane or the like for raising the raisable and lowerable member as compared to a configuration for raising the raisable and lowerable member by hoisting the raisable and lowerable member. Accordingly, this configuration provides a cost advantage.

Moreover, according to this method, the raising rope is wound up while being supported at a position above from the upper surface of the boom by the rope support member. Therefore, an interference between the raising rope and the upper surface of the boom and various members mounted on the upper surface can be prevented. In addition, according to this method, a vertical movement of the raising rope is restricted by the upper restriction section and the lower restriction section of the rope support member. Accordingly, a vertical swing of the raising rope during the winding up of the raising rope can be reduced, whereby the interference between the raising rope and the other members caused by the vertical swing can also be suppressed. Thus, damage to the raising rope can more reliably be suppressed.

The present invention also provides a method for raising a raisable and lowerable member of a crane equipped with a machine body, a boom mounted to the machine body in a raisable and lowerable manner, the raisable and lowerable member raisable and lowerable with respect to the boom, a support member that supports the boom and is raisable and lowerable with respect to the machine body, and a connection member for connecting a distal end of the boom and a distal end of the support member, the method comprising: a support member raising step of raising the support member with respect to the machine body rearward of the boom in the front-rear direction of the boom, in a state where the raisable and lowerable member and the boom are laid down along an installation surface on which the crane is placed with the raisable and lowerable member extending forward of the boom in a front-rear direction of the boom, such that the connection member obliquely extends forward and downward from the distal end of the support member toward the distal end of the boom; a rope routing step of coupling a raising rope to the raisable and lowerable member and routing the raising rope to extend rearward of the raisable and lowerable member in the front-rear direction of the boom; and a raising step of winding up the raising rope rearward in the front-rear direction of the boom to raise the raisable and lowerable member with respect to the boom, the raising step being executed after the support member raising step and the rope routing step, wherein in the rope routing step, the raising rope is routed to pass between an upper restriction section and a lower restriction section of a rope support member attached to the connection member, the lower restriction section being disposed at a position closer to the boom than the raising rope to support the raising rope at a position above an upper surface of the boom while allowing a movement of the raising rope in the front-rear direction of the boom, the upper restriction section being disposed at a position farther away from the boom than the raising rope to be contactable with the raising rope, and in the raising step, the raising rope is wound up rearward in the front-rear direction of the boom with an upward movement of the raising rope restricted by the upper restriction section and a downward movement of the raising rope restricted by the lower restriction section.

According to this method, the raisable and lowerable member is also raised by winding up the raising rope coupled to the raisable and lowerable member, whereby it is unnecessary to prepare a crane or the like for hoisting the raisable and lowerable member. Accordingly, this configuration provides a cost advantage. Moreover, the raising rope is wound up while being supported at a position above from the upper surface of the boom by the rope support member. Therefore, an interference between the raising rope and the upper surface of the boom and the like can be prevented. In addition, a vertical movement of the raising rope is restricted by the upper restriction section and the lower restriction section of the rope support member. Accordingly, the interference between the raising rope and the other members caused by the vertical swing of the raising rope can also be suppressed. Thus, damage to the raising rope can more reliably be suppressed.

Moreover, according to this method, the rope support member is attached to the connection member obliquely extending forward and downward from the distal end of the support member toward the distal end of the raisable and lowerable member. Therefore, the distance from the upper surface of the boom to the rope support member and the raising rope supported by the rope support member can be increased with the vertical size of the rope support member being reduced. Accordingly, works for attaching and carrying the rope support member arc facilitated, while the interference between the raising rope and the upper surface of the boom and the like can effectively be prevented.

It is preferable that, in the above method, the lower restriction section includes a rotary body rotatable about an axis orthogonal to the front-rear direction of the boom and extending along the installation surface, and in the raising step, the raising rope is wound up rearward in the front-rear direction of the boom, while the rotary body supports the raising rope on an outer peripheral surface of the rotary body and rotates with the rearward movement of the raising rope.

According to this configuration, the raising rope can be wound up with an interference between the raising rope and the upper surface of the boom and the like being suppressed.

The present invention also provides a crane comprising: a machine body; a boom mounted to the machine body in a

raisable and lowerable manner; a raisable and lowerable member mounted in a raisable and lowerable manner with respect to the boom; and a rope support member that is attached to the boom to support a raising rope coupled to the raisable and lowerable member, wherein the rope support member includes a lower restriction section and an upper restriction section, the lower restriction section being disposed at a position closer to the boom than the raising rope to support the raising rope at a position above an upper surface of the boom while allowing a movement of the raising rope in a front-rear direction of the boom in a preparatory state where the raisable and lowerable member and the boom are laid down along an installation surface on which the crane is placed with the boom extending forward of the machine body in the front-rear direction of the boom and with the raisable and lowerable member extending forward of the boom in the front-rear direction of the boom, the upper restriction section being disposed at a position farther away from the boom than the raising rope to be contactable with the raising rope in the preparatory state.

According to the crane described above, when the raising rope routed to extend rearward from the raisable and lowerable member in the preparatory state is moved in the front-rear direction, the raising rope can be supported at a position above the upper surface of the boom by the rope support member. Therefore, an interference between the raising rope and the upper surface of the boom and the like can be prevented. In addition, a vertical movement of the raising rope is restricted by the upper restriction section and the lower restriction section of the rope support member. Accordingly, a vertical swing of the raising rope during the movement of the raising rope can be reduced, whereby the interference between the raising rope and the other members caused by the vertical swing can also be suppressed. Thus, damage to the raising rope can more reliably be suppressed.

It is preferable that, in the above configuration, the lower restriction section rotates about an axis orthogonal to the front-rear direction of the boom and extending along the installation surface, along with a movement of the raising rope in the front-rear direction of the boom, to allow the movement of the raising rope in the front-rear direction of the boom.

According to this configuration, the rope coupled to the raisable and lowerable member and supported by the rope support member can smoothly be moved in the front-rear direction.

This application is based on Japanese Patent application No. 2017-067692 filed in Japan Patent Office on Mar. 30, 2017, the contents of which are hereby incorporated by reference.

Although the present invention has been fully described by way of example with reference to the accompanying drawings, it is to be understood that various changes and modifications will be apparent to those skilled in the art. Therefore, unless otherwise such changes and modifications depart from the scope of the present invention hereinafter defined, they should be construed as being included therein.

The invention claimed is:

1. A method for raising a raisable and lowerable member of a crane equipped with a machine body, a boom mounted to the machine body in a raisable and lowerable manner, and the raisable and lowerable member being raisable and lowerable with respect to the boom,

the method comprising:

a rope routing step of coupling a raising rope to the raisable and lowerable member, in a state where the raisable and lowerable member and the boom are laid down along an installation surface on which the crane is placed, the boom extending forward of the machine body in a front-rear direction of the boom, and the raisable and lowerable member extending forward of the boom in the front-rear direction of the boom, and routing the raising rope to let the raising rope extend rearward of the raisable and lowerable member in the front-rear direction of the boom; and

a raising step of winding up the raising rope rearward in the front-rear direction of the boom to raise the raisable and lowerable member with respect to the boom, the raising step being executed after the rope routing step,

wherein

in the rope routing step, the raising rope is routed to pass between an upper restriction section and a lower restriction section of a rope support member attached to the boom, the lower restriction section being disposed at a position closer to the boom than the raising rope to support the raising rope at a position above an upper surface of the boom while allowing a movement of the raising rope in the front-rear direction of the boom, the upper restriction section being disposed at a position farther away from the boom than the raising rope to be contactable with the raising rope, and

in the raising step, the raising rope is wound up rearward in the front-rear direction of the boom, while the upper restriction section restricts an upward movement of the raising rope and the lower restriction section restricts a downward movement of the raising rope.

2. A method for raising a raisable and lowerable member of a crane equipped with a machine body, a boom mounted to the machine body in a raisable and lowerable manner, the raisable and lowerable member being raisable and lowerable with respect to the boom, a support member that supports the boom and is raisable and lowerable with respect to the machine body, and a connection member for connecting a distal end of the boom and a distal end of the support member,

the method comprising:

a support member raising step of raising the support member with respect to the machine body rearward of the boom in the front-rear direction of the boom, in a state where the raisable and lowerable member and the boom are laid down along an installation surface on which the crane is placed, the raisable and lowerable member extending forward of the boom in a front-rear direction of the boom, such that the connection member obliquely extends forward and downward from the distal end of the support member toward the distal end of the boom;

a rope routing step of coupling a raising rope to the raisable and lowerable member, and routing the raising rope to extend rearward of the raisable and lowerable member in the front-rear direction of the boom; and

a raising step of winding up the raising rope rearward in the front-rear direction of the boom to raise the raisable and lowerable member with respect to the boom, the raising step being executed after the support member raising step and the rope routing step,

wherein

in the rope routing step, the raising rope is routed to pass between an upper restriction section and a lower restriction section of a rope support member attached to the boom, the lower restriction section being disposed at a position closer to the boom than the raising rope to support the raising rope at a position above an upper surface of the boom while allowing a movement of the

raising rope in the front-rear direction of the boom, the upper restriction section being disposed at a position farther away from the boom than the raising rope to be contactable with the raising rope, and

in the raising step, the raising rope is wound up rearward in the front-rear direction of the boom, an upward movement of the raising rope being restricted by the upper restriction section, a downward movement of the raising rope being restricted by the lower restriction section.

3. The method for raising a raisable and lowerable member according to claim **1**, wherein

the lower restriction section includes a rotary body rotatable about an axis orthogonal to the front-rear direction of the boom and extending along the installation surface, and

in the raising step, the raising rope is wound up rearward in the front-rear direction of the boom, while the rotary body supports the raising rope on an outer peripheral surface of the rotary body and rotates with the rearward movement of the raising rope.

4. The method for raising a raisable and lowerable member according to claim **2**, wherein

the lower restriction section includes a rotary body rotatable about an axis orthogonal to the front-rear direction of the boom and extending along the installation surface, and

in the raising step, the raising rope is wound up rearward in the front-rear direction of the boom, while the rotary body supports the raising rope on an outer peripheral surface of the rotary body and rotates with the rearward movement of the raising rope.

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